

Application Number 10/825,964
Amendment dated February 20, 2007
Responsive to Office Action mailed November 17, 2006

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AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims:

Claim 1 (Withdrawn): A method comprising:
monitoring a plurality of physiological parameters of a patient; and
determining within an implantable medical device a value of a sleep metric that indicates a probability of the patient being asleep based on the physiological parameters.

Claim 2 (Withdrawn): The method of claim 1, wherein the physiological parameters comprise at least one of activity level, posture, heart rate, respiration rate, respiratory volume, or core temperature.

Claim 3 (Withdrawn): The method of claim 1, wherein the physiological parameters comprise at least one of blood pressure, blood oxygen saturation, partial pressure of oxygen within blood, partial pressure of oxygen within cerebrospinal fluid, muscular activity, core temperature, arterial blood flow, or galvanic skin response.

Claim 4 (Withdrawn): The method of claim 1, further comprising determining a variability of at least one of the physiological parameters, wherein determining a value of the sleep metric comprises determining the value of the sleep metric based on the variability.

Claim 5 (Withdrawn): The method of claim 1, further comprising determining at least one of a mean value or a median value for at least one of the physiological parameters, wherein determining a value of a sleep metric comprises determining the sleep metric based on the at least one of the mean value and the median value.

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Claim 6 (Withdrawn): The method of claim 1, wherein determining a value of a sleep metric comprises determining a value for each of a plurality of sleep metrics, each of the values determined based on a respective one of the physiological parameters.

Claim 7 (Withdrawn): The method of claim 6, wherein determining a value of a sleep metric comprises determining a value of an overall sleep metric based on the plurality of sleep metric values.

Claim 8 (Withdrawn): The method of claim 7, wherein determining a value of an overall sleep metric comprises averaging the values of the plurality of sleep metrics.

Claim 9 (Withdrawn): The method of claim 7, wherein determining a value of an overall sleep metric comprises applying a weighting factor to a value of at least one of the plurality of sleep metrics.

Claim 10 (Withdrawn): The method of claim 1, further comprising:
comparing the value of the sleep metric to a threshold value; and
determining within the implantable medical device whether the patient is asleep based on the comparison.

Claim 11 (Withdrawn): The method of claim 10, further comprising:
comparing the value of the sleep metric to a plurality of thresholds; and
determining within the implantable medical device a sleep state of the patient based on the comparison.

Claim 12 (Withdrawn): The method of claim 11, wherein determining a sleep state of the patient comprises determining whether the patient is in one of a rapid eye movement (REM) sleep state or a nonrapid eye movement (NREM) sleep state.

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Claim 13 (Withdrawn): The method of claim 10, wherein the threshold value is selected by a user.

Claim 14 (Withdrawn): The method of claim 10, further comprising controlling delivery of a therapy from the implantable medical device to the patient based on the determination of whether the patient is asleep.

Claim 15 (Withdrawn): The method of claim 10, further comprising storing information within the implantable medical device indicating when the patient is asleep for retrieval by a user.

Claim 16 (Withdrawn): The method of claim 15, further comprising evaluating the effectiveness of a therapy delivered from the implantable medical device to the patient based on the information indicating whether the patient is asleep.

Claim 17 (Withdrawn): The method of claim 16, wherein the therapy comprises at least one of a neurostimulation or a drug therapy.

Claim 18 (Withdrawn): The method of claim 16, wherein the therapy is a pain therapy.

Claim 19 (Previously Presented): A medical system comprising:
a plurality of sensors, each of the sensors generating a signal as a function of at least one physiological parameter of a patient; and
an implantable medical device that includes a processor that monitors a plurality of physiological parameters of the patient based on the signals output by the sensors, and determines a value of a sleep metric that indicates a probability of the patient being asleep based on the physiological parameters.

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Claim 20 (Previously Presented): The system of claim 19, wherein the physiological parameters comprise at least one of activity level, posture, heart rate, respiration rate, respiratory volume, or core temperature.

Claim 21 (Previously Presented): The system of claim 19, wherein physiological parameters comprise at least one of blood pressure, blood oxygen saturation, partial pressure of oxygen within blood, partial pressure of oxygen within cerebrospinal fluid, muscular activity, arterial blood flow, or galvanic skin response.

Claim 22 (Original): The system of claim 19, wherein the processor determines a variability of at least one of the physiological parameters, and determines the sleep metric based on the variability.

Claim 23 (Original): The system of claim 19, wherein the processor determines at least one of a mean value and a median value of at least one of the physiological parameters, and determines the sleep metric based on the at least one of the mean value and the median value.

Claim 24 (Original): The system of claim 19, wherein the processor determines a value of each of a plurality of sleep metrics, each of the plurality of values determined based on a respective one of the physiological parameters.

Claim 25 (Currently Amended): The system of claim 24, wherein the processor determines a value of an overall sleep metric based on the values of the plurality of sleep metrics.

Claim 26 (Original): The system of claim 25, wherein the processor determines the value of the overall sleep metric by averaging the values of the plurality of sleep metrics.

Claim 27 (Original): The system of claim 26, wherein the processor applies a weighting factor to at least one of values of the plurality of sleep metrics.

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Claim 28 (Original): The system of claim 19, further comprising a memory to store a threshold value, wherein the processor compares the value of the sleep metric to a threshold value and determines whether the patient is asleep based on the comparison.

Claim 29 (Original): The system of claim 28, wherein the memory stores a plurality of threshold values, and the processor compares the value of the sleep metric to each of the threshold values and determines a sleep state of the patient based on the comparison.

Claim 30 (Previously Presented): The system of claim 29, wherein the processor determines whether the patient is in one of a rapid eye movement (REM) sleep state or a nonrapid eye movement (NREM) sleep state.

Claim 31 (Original): The system of claim 28, further comprising a user interface, wherein a user selects the threshold via the user interface.

Claim 32 (Previously Presented): The system of claim 28, wherein the processor controls delivery of a therapy to the patient by the implantable medical device based on the determination of whether the patient is asleep.

Claim 33 (Original): The system of claim 28, wherein the processor stores information indicating when the patient is asleep within the memory for retrieval by a user.

Claim 34 (Canceled).

Claim 35 (Previously Presented): The system of claim 19, wherein the implantable medical device includes the sensor.

Claim 36 (Previously Presented): The system of claim 19, wherein the implantable medical device is coupled to the sensor via a lead.

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Claim 37 (Previously Presented): The system of claim 19, wherein the implantable medical device is wirelessly coupled to the sensor.

Claim 38 (Previously Presented): The system of claim 19, wherein the implantable medical device comprises at least one of an implantable neurostimulator or an implantable pump.

Claim 39 (Previously Presented): A system comprising:
means for monitoring a plurality of physiological parameters of a patient; and
implantable means for determining a value of a sleep metric that indicates a probability of the patient being asleep based on the physiological parameters.

Claim 40 (Original): The system of claim 39, further comprising means for generating at least one signal as a function of the physiological parameters, wherein the means for monitoring comprises means for monitoring the physiological parameters based on the signal.

Claim 41 (Original): The system of claim 39, wherein the means for determining a sleep metric comprises means for determining a value for each of a plurality of sleep metrics, each of the plurality of values determined based on a respective one of the physiological parameters.

Claim 42 (Original): The system of claim 41, wherein the means for determining a value of a sleep metric comprises means for determining a value of an overall sleep metric based the values of the plurality of sleep metrics.

Claim 43 (Original): The system of claim 41, further comprising means for comparing the value of the sleep metric to a threshold value and determining whether the patient is asleep based on the comparison.

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Claim 44 (Original): The system of claim 43, further comprising:

means for delivering a therapy to the patient; and

means for controlling delivery of a therapy to the patient by the therapy delivery means based on the determination of whether the patient is asleep.

Claim 45 (Original): The system of claim 43, further comprising means for storing information indicating when the patient is asleep for retrieval by a user.

Claim 46 (Withdrawn): A method comprising:

monitoring a physiological parameter of a patient via an implantable medical device, wherein the physiological parameter comprises one of blood pressure, muscular activity, arterial blood flow, and galvanic skin response; and

determining whether a patient is asleep based on the physiological parameter.

Claim 47 (Withdrawn): The method of claim 46, wherein monitoring a physiological parameter comprises monitoring a plurality of physiological parameters, and wherein determining whether a patient is asleep comprises determining whether the patient is asleep based on the plurality of physiological parameters.

Claim 48 (Withdrawn): The method of claim 47, wherein determining whether a patient is asleep comprises:

determining a value of a sleep metric that indicates a probability of the patient being asleep based on the plurality of physiological parameters;

comparing the value of the sleep metric to a threshold value; and

determining whether the patient is asleep based on the comparison.

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Claim 49 (Withdrawn): The method of claim 48, wherein determining a sleep metric comprises:

determining a value of a sleep metric for each of the plurality of monitored physiological parameters; and

determining a value of an overall sleep metric based on the values of the plurality of sleep metrics, and

wherein determining whether the patient is asleep comprises determining whether the patient is asleep based on comparison of the value of the overall sleep metric to the threshold.

Claim 50 (Withdrawn): The method of claim 46, further comprising controlling delivery of a therapy to the patient based on the determination of whether the patient is asleep.

Claim 51 (Withdrawn): The method of claim 46, further comprising storing information indicating when the patient is asleep for retrieval by a user.

Claim 52 (Withdrawn): The method of claim 51, further comprising evaluating the effectiveness of a therapy delivered to the patient based on the information indicating whether the patient is asleep.

Claim 53 (Currently Amended): A medical system comprising:
a sensor to generate a signal as a function of a physiological parameter of a patient, wherein the physiological parameter comprises one of blood pressure, muscular activity, arterial blood flow, or galvanic skin response; and
an implantable medical device that includes a processor to monitor the physiological parameter based on the signal and determine a probability of whether a the patient is being asleep based on the physiological parameter.

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Claim 54 (Currently Amended): The system of claim 53,
further comprising a plurality of sensors that generate a signal as a function of a
physiological parameter of a patient,
wherein the processor monitors a plurality of physiological parameters based on the
signals and determines the probability of whether the patient is being asleep based on the
plurality of physiological parameters.

Claim 55 (Currently Amended): The system of claim 54,
wherein the implantable medical device further comprises a memory to store a threshold
value, and
wherein the processor determines a value of a sleep metric that indicates a sleep state of
the patient based on the plurality of physiological parameters, compares the value of the sleep
metric to a threshold value, and determines the probability of whether the patient is being asleep
based on the comparison.

Claim 56 (Currently Amended): The system of claim 55, wherein the processor determines a
value of a sleep metric for each of the plurality of monitored physiological parameters,
determines a value of an overall sleep metric based on the values of the plurality of sleep metrics,
and determines the probability of whether the patient is being asleep based on comparison of the
value of the overall sleep metric to the threshold.

Claim 57 (Currently Amended): The system of claim 53, wherein the processor controls
delivery of a therapy to the patient based on the determination of the probability of whether the
patient is being asleep.

Claim 58 (Original): The system of claim 53,
wherein the implantable medical device further comprises a memory, and
wherein the processor stores information indicating when the patient is asleep within the
memory for retrieval by a user.

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Claim 59 (Original): The system of claim 53, wherein the implantable medical device includes the sensor.

Claim 60 (Currently Amended): The system of claim 53, wherein the implantable medical device is coupled to the sensor via a lead.

Claim 61 (Original): The system of claim 53, wherein the implantable medical device is wirelessly coupled to the sensor.

Claim 62 (Previously Presented): The system of claim 53, wherein the implantable medical device comprises at least one of an implantable neurostimulator or an implantable pump.

Claim 63 (Withdrawn): A computer-readable medium comprising instructions that cause a programmable processor within an implantable medical device to:

- monitor a plurality of physiological parameters of a patient; and
- determine a value of a sleep metric that indicates a probability of the patient being asleep based on the physiological parameters.

Claim 64 (Withdrawn): The medium of claim 63, further comprising instructions that cause the processor to determine a variability of at least one of the physiological parameters, wherein the instructions that cause the processor to determine a value of the sleep metric comprise instructions that cause the processor to determine the value of the sleep metric based on the variability.

Claim 65 (Withdrawn): The medium of claim 63, further comprising instructions that cause the processor to:

- determine a value for each of a plurality of sleep metrics, each of the values determined based on a respective one of the physiological parameters; and
- determine a value of an overall sleep metric based on the plurality of sleep metric values.

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Claim 66 (Withdrawn): The medium of claim 63, further comprising instructions that cause the processor to:

compare the value of the sleep metric to a threshold value; and
determine whether the patient is asleep based on the comparison.

Claim 67 (Withdrawn): The method of claim 66, further comprising instructions that cause the processor to:

compare the value of the sleep metric to a plurality of thresholds; and
determine a sleep state of the patient based on the comparison.

Claim 68 (Withdrawn): The medium of claim 67, wherein the instructions that cause the processor to determine a sleep state of the patient comprise instructions that cause the processor to determine whether the patient is in one of a rapid eye movement (REM) sleep state or a nonrapid eye movement (NREM) sleep state.

Claim 69 (New): The medical system of claim 19, wherein the value of the sleep metric comprises a number within a range of about 0 to about 1.

Claim 70 (New): The system of claim 39, wherein the value of the sleep metric comprises a number within a range of about 0 to about 1.

Claim 71 (New): The medical system of claim 53, wherein the processor determines a sleep metric that indicates the probability of the patient being asleep based on the physiological parameter, the sleep metric comprising a probability value within a range of about 0 to about 1.